RISK-BASED DECISION-MAKING GUIDELINES

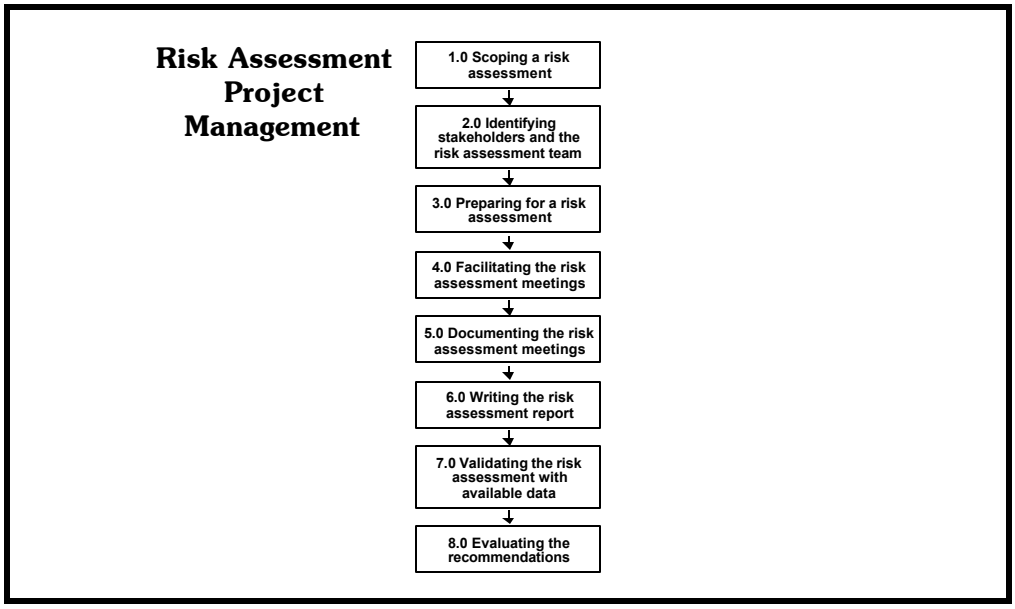
Volume 3
Procedures for Assessing Risks

Getting Started with Risk Assessment

Chapter 2 — Managing a Risk Assessment Project

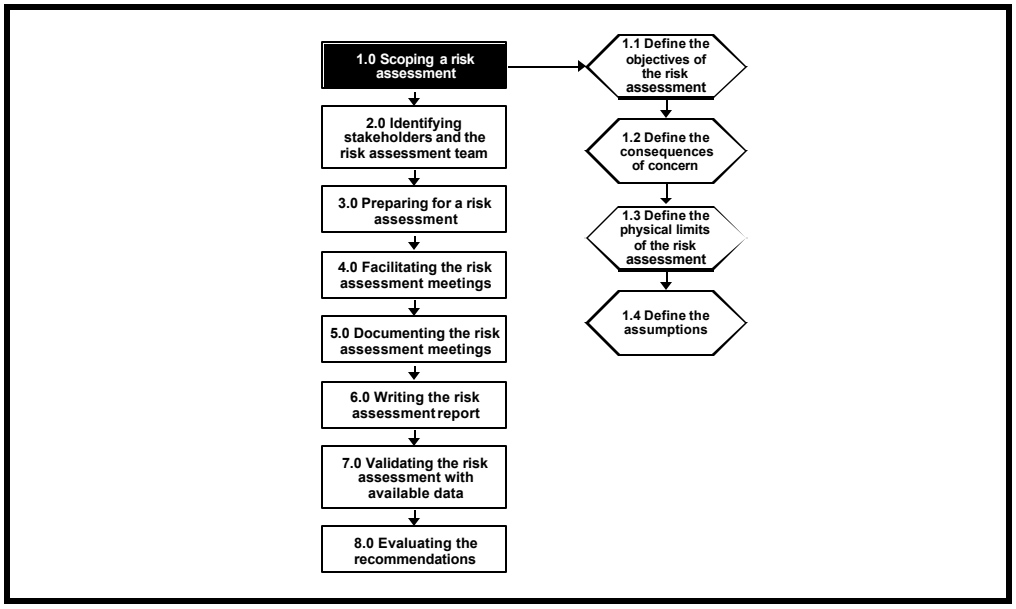
Chapter Contents

This chapter provides a basic overview of project management techniques for a risk assessment project. The following are the major topics in this chapter:



Overview of Risk Assessment Project Management

Selecting the right approach and tools for your application is important, but it does not guarantee success. In fact, the way you implement an approach generally has more influence on your ultimate success than the approach itself. For example, an expert craftsman can often accomplish more with rudimentary tools than a novice can with even the most sophisticated power tools. To help ensure a successful risk assessment, it is important to perform several activities related to managing the project. This chapter discusses these project management steps, as shown above, and their importance to the success of the risk assessment.



1.0 Scoping a Risk Assessment

Defining the scope of a risk assessment is critical to success. A lack of clear direction can waste time and resources, causing the team to examine issues of relatively minor interest or concern.

The scope provides the boundaries necessary to focus the risk assessment objectives. However, it is important that the scope not be defined so restrictively that it stifles the risk assessment team. The team must have the latitude to exercise good judgment in the investigation of issues initially outside the scope. Fundamentally, the risk assessment should be scoped to address the issues at the highest level possible while still satisfying the necessary objectives.

Following are the major choices that define the scope of any risk assessment:

1.1 Define the objectives of the risk assessment

- Determine the motivation for performing the risk assessment. This may include management concern, unit concern, public concern, or regulatory compliance
- Determine the operating modes to be considered
- Develop a *wish list* of information desired from the risk assessment

1.2 Define the consequences of concern

- Public injury
- Personnel injury
- Equipment or property damage
- Environmental damage
- Revenue loss
- Community relations

1.3 Define the physical limits of the risk assessment

The physical limits of the risk assessment include the breadth and depth of the risk assessment, the uncertainty of results, and the availability of resources.

Breadth of risk assessment. This issue focuses on what is to be analyzed. If overall risk-related information for an activity or system is needed, the risk assessment scope should include all associated operations or subsystems. For example, a risk assessment might ask, "What is the total risk of contained operations?" However, if information needs are restricted to specific functions or components, a narrow focus on that equipment is appropriate. Such a focus might ask the question, "What is the risk associated with the boom crane?" The breadth of risk assessment should be as narrow as possible without overlooking potentially important contributors to activity or system performance. For example, if an emergency shutdown system were an issue, a risk assessment would typically need to focus both on the components of that system and its interfaces with other systems.

Depth of risk assessment. This issue focuses on the level of resolution within the risk assessment. That is, "How detailed an evaluation is required for each entity within the breadth of risk assessment?" Risk assessments should generally be performed in stages, progressing one level at a time. For example, an overall activity assessment would be performed at an operation level. The operation contributing most of the potential problems could then be assessed in more detail, if more detailed information were judged to be beneficial to decision makers. This process would be repeated in assessing important operations at the function level, important functions at the component level, etc. This concept can be considered a hierarchy.

- Overall Activity
  - Operations
    - Functions
      - Components

A progressive level of resolution that focuses on the most significant areas produces an efficient risk assessment, without overworking problems.

Uncertainty of results. This issue focuses on the level of confidence that decision makers require from risk assessment results. Very detailed numerical estimates characterizing expected risk are sometimes necessary. These numerical estimates often include statistical confidence bounds. However, subjective, qualitative judgments about expected risk are tolerable for many risk assessments. Of course, various levels of risk assessment between these extremes are possible, including categorization methods. The need for greater certainty is generally associated with the following:

1. **More severe consequences if systems are unreliable.** If a specific human error or equipment failure could result in a catastrophic accident, as opposed to only a minor inconvenience, then the risk assessment may need to be more refined.

2. **Lack of familiarity or experience with new systems.** Risk assessments of new designs are often more detailed and systematic than those of activities and systems that have been performed successfully for many years.

3. **Requirements for demonstrating compliance with numerical goals.** Risk assessments demonstrating that components can achieve specific risk goals would require a more precise study than those for qualitatively identifying failure modes.

Using the highest tolerable level of uncertainty that does not affect decision making minimizes risk assessment burdens without compromising results.

A risk analyst must be open and honest about any assumptions made in scoping the risk assessment and the degree of uncertainty expected in the results. These assumptions and expected uncertainties in results must be captured in the risk assessment project so that (1) the decision maker can use them as factors in his or her final decision and (2) they can serve as points from which future, similar risk assessments can be validated.

Availability of resources. This issue focuses on what type of risk assessment is feasible, given limited time, money, and personnel resources. A surplus of resources is not a reason to perform more analysis than necessary; however, inadequate resources may necessitate a more restrictive scope than would have been selected otherwise.

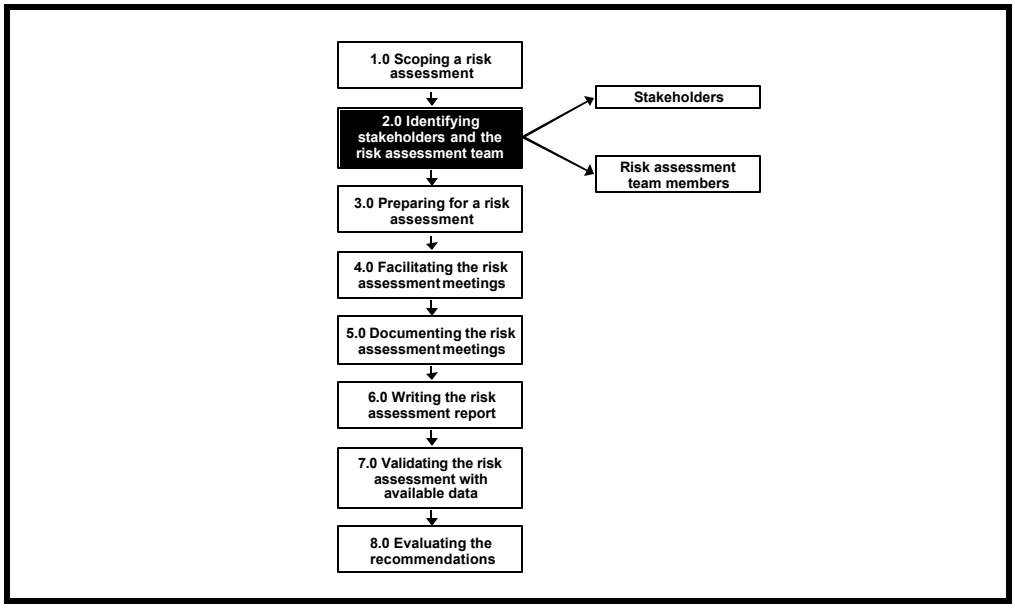
1.4 Define the assumptions

Clearly defined assumptions help ensure a consistent risk assessment. Here are some typical assumptions:

- Equipment is fit for its intended use
- Trained personnel will be used
- Written procedures are accurate
- Policies are enforced

In summary

In scoping a risk assessment, it is best to make the assessment the minimum necessary to satisfy its objectives. In other words, aim for a risk assessment that addresses the issue at the highest level possible, tolerating the most possible uncertainty and using the fewest possible resources.



2.0 Identifying Stakeholders and the Risk Assessment Team

Stakeholders

There are five types of individuals or groups who participate in the risk assessment process:

Sponsor — This individual or group determines the need for the particular risk assessment. The sponsor is ultimately responsible for obtaining results from the risk assessment and typically has a specific use for the results.

Analyst — This individual or group, such as an SEH or risk specialist, is responsible for performing the risk assessment.

Subject matter experts — This group participates in the risk assessment, providing expert knowledge and experience about relevant operations, configurations, and potential problems. It may include unit staff and outside experts.

Decision maker — This individual or group uses the risk assessment process results to make risk-based decisions. The decision maker is often the sponsor.

Others affected by the decision — This group can include internal or external organizations as well as individuals who will likely be affected by the risk-based decision. This group should be appropriately represented throughout the risk assessment process.

Risk assessment team members

The risk assessment team consists of **analysts** and **subject matter experts**. Risk assessments are sometimes performed solely by analysts in a one-person team, but the best risk assessments always involve activity and system experts.

Following is a more detailed description of the risk assessment team members:

Analysts *— act as either team leaders or scribes*

Team leader *— organizes and facilitates the analysis*

Characteristics:

- Independent of subject activity or system; not the activity or system expert
- Able to organize and negotiate
- Communicates well with a diverse group
- Can focus group energy and build consensus
- Impartial, honest, and ethical
- Experienced with risk analysis techniques

Scribe *— records the proceedings of the analysis in an orderly manner*

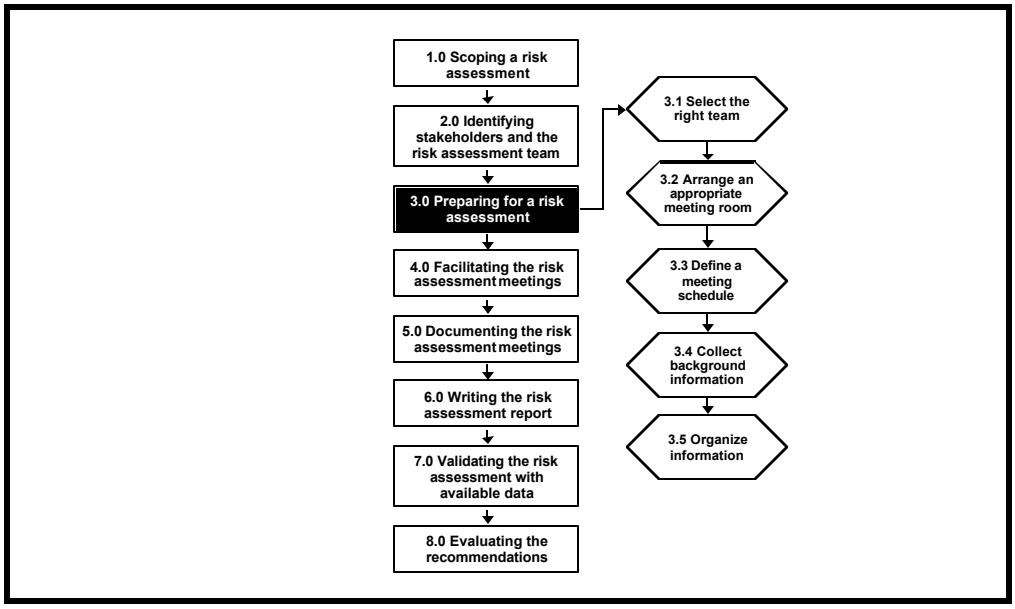
Characteristics:

- Attentive to detail
- Able to organize
- Understands technical terminology
- Able to summarize discussions
- Good writing and typing skills
- Understands the risk assessment techniques

Subject matter experts *— postulate causes, estimate consequences, identify safeguards, and suggest ways to address unacceptable loss exposures*

Characteristics:

- Enter into the discussion enthusiastically
- Contribute their experience
- Confine the discussion to the specific problem
- Listen attentively to the discussion
- Appreciate other team members' points of view



3.0 Preparing for a Risk Assessment

Preparing for a risk assessment is as crucial as performing the assessment. Poor preparation can undermine the analysis. The analysts and sponsor should work together to ensure that the risk assessment runs smoothly.

3.1 Select the right team

- Choose an appropriate number of team members. This is often three to six for team-based approaches.
- Appoint team members with a variety of experience and expertise
- Ensure that team members are objective
- Consider and balance the personality traits of individuals on the team; avoid disruptive people
- Balance the positions of the individuals on the team; managers and officers may intimidate some individuals, keeping them from contributing
- Consider the impact on operations

3.2 Arrange an appropriate meeting room

- Verify that the room is large enough to accommodate the team members
- Ensure that seating arrangements are comfortable
- Consider using an onsite location that accommodates tours and inspections; an offsite location may be necessary if team members are likely to be interrupted or called out during the analysis
- Consider using a room near restrooms and refreshments if possible
- Avoid distractions such as phones, loud speakers, other noises, etc.

3.3 Define a meeting schedule

- Meetings should not exceed four to six hours per day
- Risk assessment meetings should not last more than four or five days in a row. Large analyses will typically meet every two or three weeks.
- Schedule ample time to document the risk assessment, resolve the recommendations, and conduct a high-level benefit-cost analysis on the recommendations
- Distribute meeting schedules early enough for team members to arrange their own schedules

3.4 Collect background information

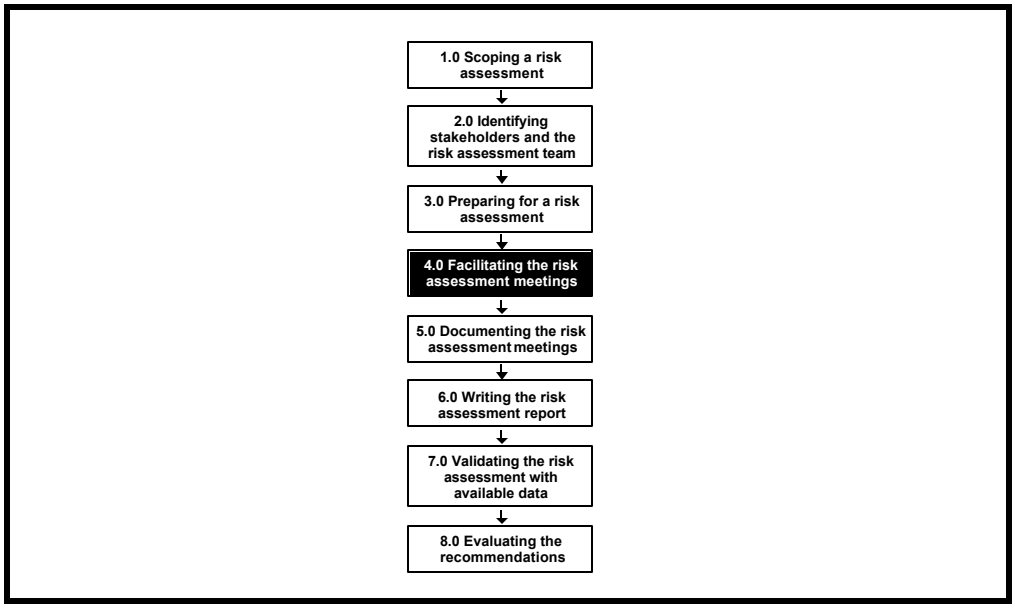
Collect appropriate drawings, procedures, policies, etc., that would be useful as references during the risk assessment. The Data Sources Compendium in the General Resources directory of Volume 4 of these *Guidelines* is a useful resource for gathering background data.

If appropriate, develop other information collection methods, such as written surveys, and obtain the results for the risk assessment. Surveys and other statistical methods to obtain reference data should be developed with expert assistance.

3.5 Organize information

Prepare documentation tools such as worksheets or software — Whether paper or software is used to document the risk assessment, the documentation tools need to be prepared in advance.

Gather and distribute information on the subject to be assessed — The team leader should gather all appropriate drawings, procedures, policies, etc., that may be necessary for reference during the risk assessment. If appropriate, this information can be distributed to the team members before the risk assessment for their review.



4.0 Facilitating the Risk Assessment Meetings

The team leader facilitates the analysis meeting. Proper organization and facilitation make the risk assessment run smoothly and promote an environment conducive to meeting its objectives. Below are some facilitation tips and issues to consider.

General meeting guidelines

- Introduce the team members
- Review the problem scope and objectives
- Define ground rules for the meeting, such as equality of team members, no problem solving
- Discuss the meeting schedule
- Perform the risk assessment section by section
- Review results with the team

Questioning techniques for the analysis

- Ask nonthreatening questions:

  "What factors do you emphasize when training new personnel?"

  or

  "What kinds of problems have you seen?"

  not

  "What kinds of mistakes have you made?"

- Treat team members as experts
- Solicit details of past accidents, and ask if similar situations could recur
- Direct questions to the quiet team members
- Confine yourself to asking questions, not providing answers

Keys to a successful meeting

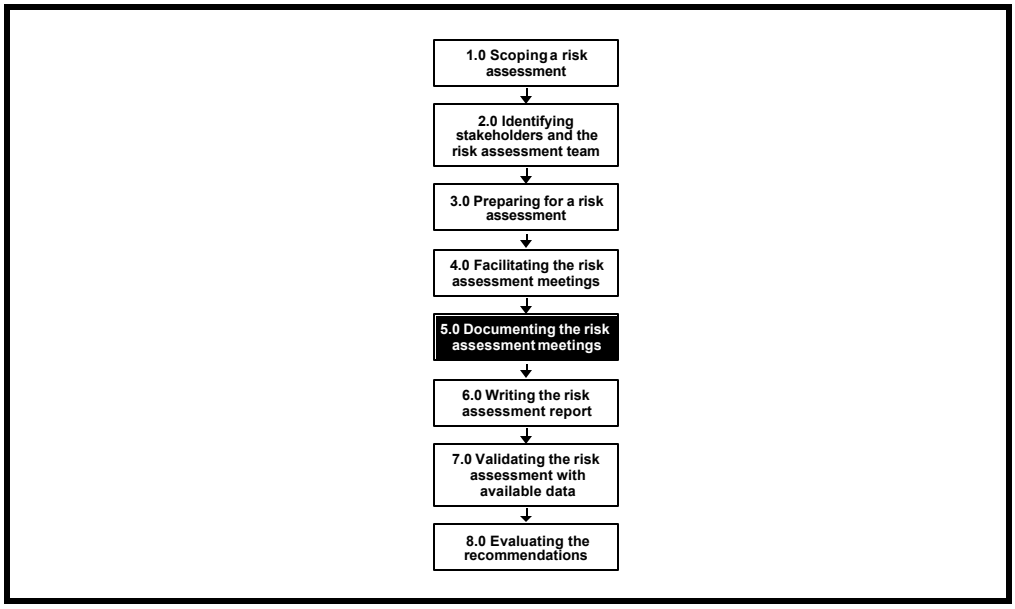
- Listen to all team members
- Promote participation; avoid criticism
- Take frequent breaks to keep energy level high, and limit meetings to four to six hours per day
- Identify ultimate causes and consequences of deviations
- Keep the meeting moving forward

Common meeting problems to avoid

- Out-of-date documentation
- Ill-defined design intentions and functions
- Inadequate information to understand the problem
- Sidetracked discussions
- Digressing into designing solutions

Follow-up activities

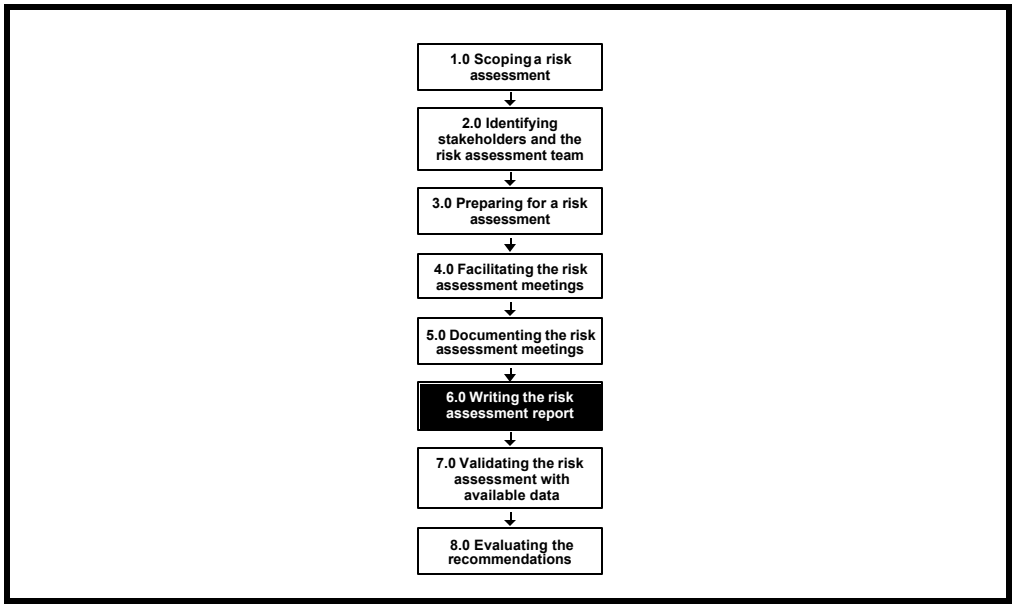
- Identify all open items (i.e., unanswered questions) that must be resolved
- Assign a person and schedule for each open item
- Review all recommendations with the team
- Schedule additional meetings as necessary



5.0 Documenting the Risk Assessment Meetings

Each risk assessment technique has its own method for collecting, organizing, and reporting data. All of these techniques can be performed using paper-based worksheets or electronic software tools, either general purpose software or technique-specific tools.

Regardless of the method used to document the analysis, the team leader and scribe should be familiar with the tools and be able to explain the documentation process to the other team members.



6.0 Writing the Risk Assessment Report

Documentation of the risk assessment results accomplishes the following:

- Provides evidence that the study was performed using sound practices
- Preserves the results for future use
- Supports other activities, such as procedures, training, and accident investigation
- Supports good management decisions

Documentation requirements should be defined before the risk assessment is performed to ensure that the proper information is collected. Below is a list of the key topics that would be included in a report:

- What was analyzed?
- Which risk assessment technique was used?
- How were the regulatory or internal requirements met?
- Who performed the risk assessment?
- What were the action items?
- What was management's response?

The following page is an example outline of a risk assessment report. Reports may be more general or more specific than this outline, depending on the intended audience and use of the documentation.

Abstract

Summary

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- 3.3 Specific Risk Assessment Issues
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4.0 Risk Assessment Results

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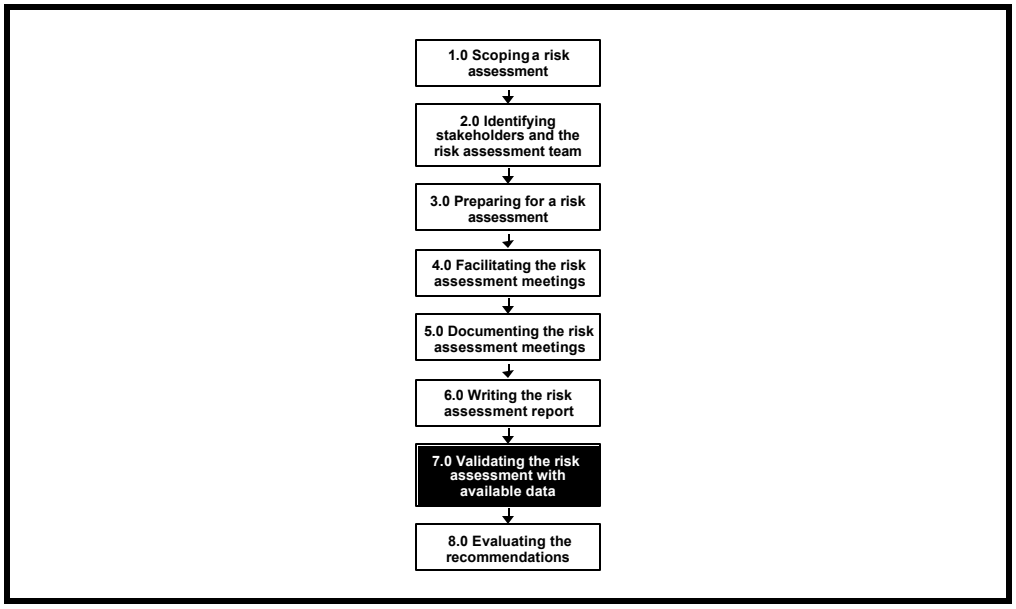
- 4.2 Recommendations
- 4.3 Concluding Remarks

Appendix A: Risk Assessment Documentation (e.g., analysis worksheets, job aids created)

Appendix B: Report Reference Material



7.0 Validating the Risk Assessment with Available Data

Once the risk assessment is complete, it should be validated in areas where applicable data are available. Two types of data are helpful for validating a risk assessment: historical data and similar risk assessments.

Historical data

Care should be taken when using historical data, such as accident statistics and past equipment failure rates. A risk assessment is used to understand future loss performance and is based on current and anticipated future operating parameters for the system. Historical data is based on past operating conditions and generally reflects a short period of time, relative to the expected frequency of recurrence for most accident scenarios. When using historical data to validate a risk assessment, be sure to understand operating conditions from the past and apply them properly to results from the risk assessment.

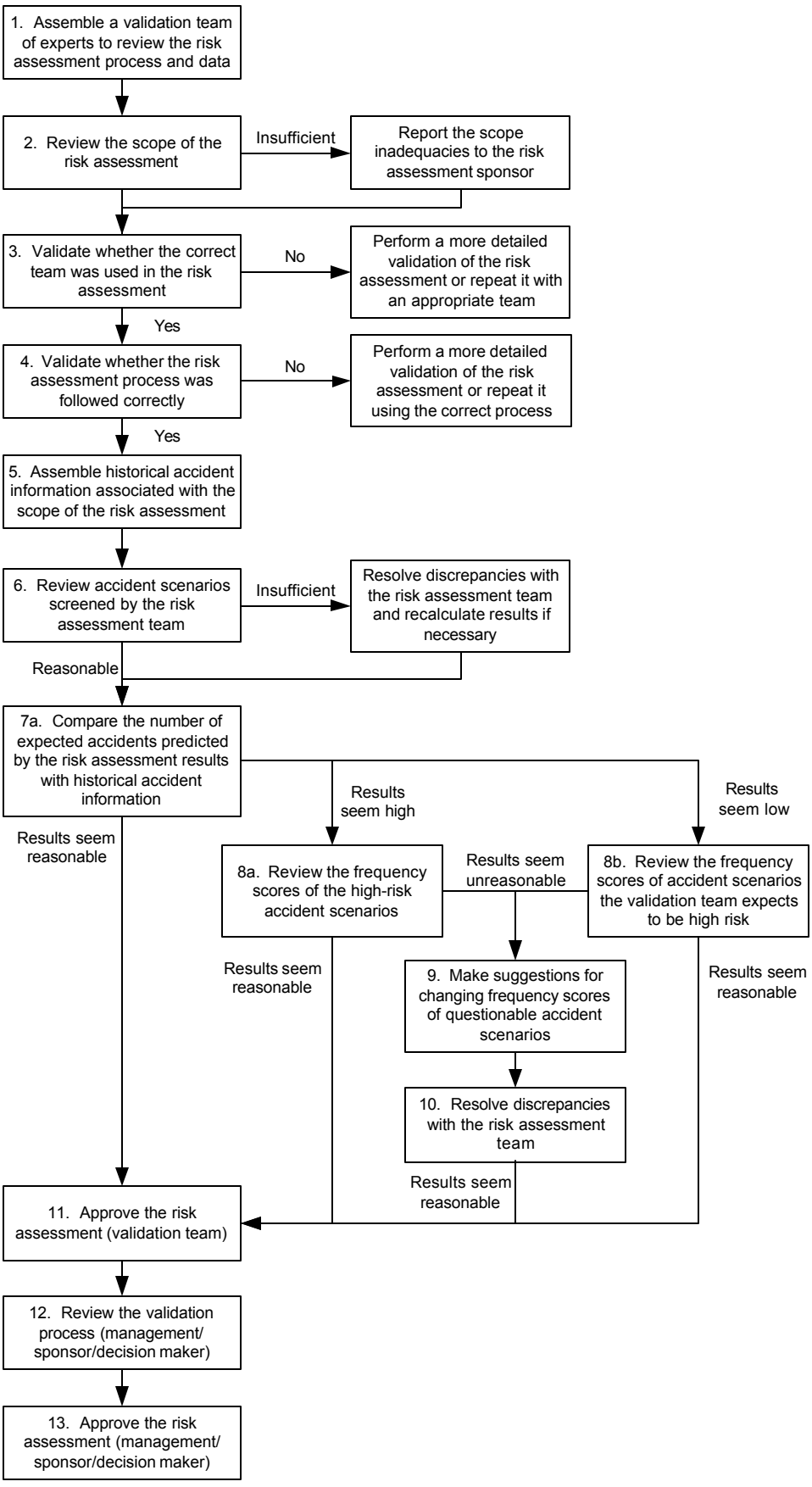
Similar risk assessments

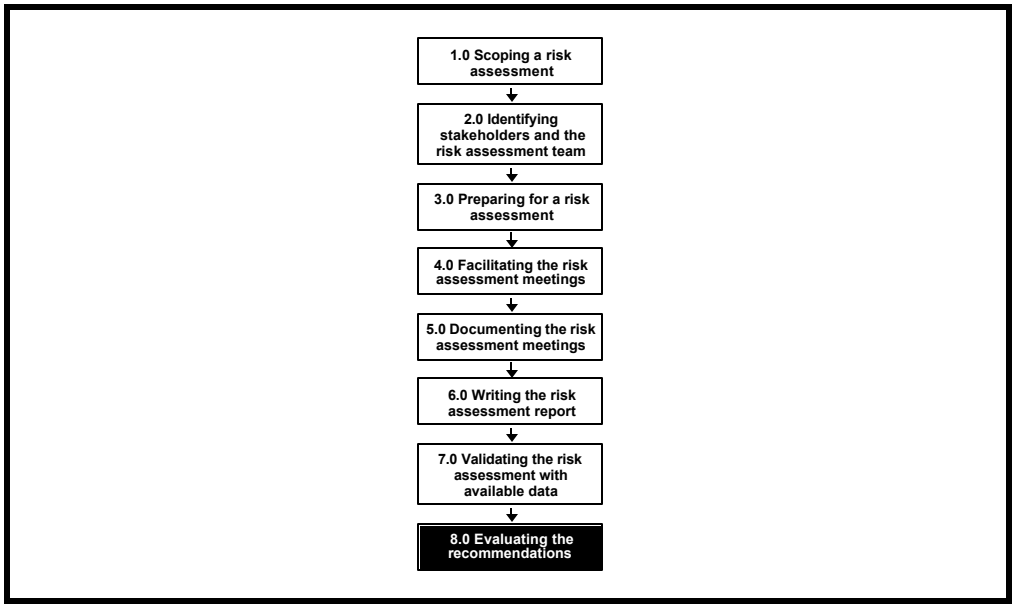
Similar risk assessments have sometimes already been conducted. These are helpful for understanding how other teams approached a risk-based decision-making application and how they evaluated the risk of similar scenarios. When using other risk assessments to validate an analysis, the context of the other risk assessments must be fully understood. Volume 4 of these *Guidelines* contains other risk assessments that have been conducted.

Risk assessment validation process

Though the following validation process can be streamlined, a standard risk assessment validation flow chart is presented on the next page. This process provides a review of all aspects of the risk assessment process and results. The validation process is designed to provide the following:

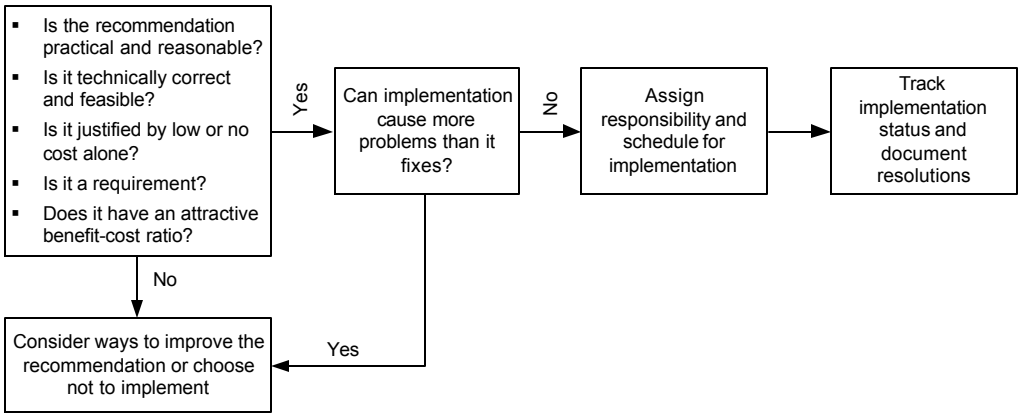
- Review of the composition of the risk assessment team
- Review of the team's performance of the risk assessment process
- Review of the risk assessment results and data


1. Assemble a validation team of experts to review the risk assessment process and data
2. Review the scope of the risk assessment
Insufficient
Report the scope inadequacies to the risk assessment sponsor
3. Validate whether the correct team was used in the risk assessment
No
Perform a more detailed validation of the risk assessment or repeat it with an appropriate team
Yes
4. Validate whether the risk assessment process was followed correctly
No
Perform a more detailed validation of the risk assessment or repeat it using the correct process
Yes
5. Assemble historical accident information associated with the scope of the risk assessment
6. Review accident scenarios screened by the risk assessment team
Insufficient
Resolve discrepancies with the risk assessment team and recalculate results if necessary
Reasonable
7a. Compare the number of expected accidents predicted by the risk assessment results with historical accident information
Results seem high
Results seem low
Results seem reasonable
8a. Review the frequency scores of the high-risk accident scenarios
Results seem unreasonable
8b. Review the frequency scores of accident scenarios the validation team expects to be high risk
Results seem reasonable
9. Make suggestions for changing frequency scores of questionable accident scenarios
Results seem reasonable
10. Resolve discrepancies with the risk assessment team
Results seem reasonable
11. Approve the risk assessment (validation team)
12. Review the validation process (management/ sponsor/decision maker)
13. Approve the risk assessment (management/ sponsor/decision maker)



8.0 Evaluating the Recommendations

The following flowchart illustrates a logical management process for evaluating recommendations.



Ideally, all recommendations from risk assessments would be (1) the most effective and efficient way of meeting the risk-related goals for the subject activity or system and (2) implemented in a timely manner.

However, this may not be the case for some of the following reasons:

- Better improvement options than those generated through the risk assessments are sometimes available
- Recommendations could sometimes inadvertently do more harm than good
- Implementation of good ideas must be delayed to allow adequate preparation time or to secure additional implementation resources

Management should therefore review the recommendations from risk assessments carefully before deciding to implement them. Management should then ensure that adopted recommendations are implemented in a timely manner. Timely resolution is important because unresolved recommendations can lead to (1) accidents from the problems they were intended to address and (2) legal or regulatory problems if major accidents occur that the recommendations could have helped prevent.

Examples of reasons for rejecting a recommendation

- A detailed engineering analysis following the risk assessment indicated that the suggestion was not a good idea because . . .
- Other information not available to the analysts indicates that the potential problem is not as significant as the analysis results indicate.
- The situation has changed; the recommendation is no longer valid because . . .
- Implementation of other recommendations makes this action no longer necessary.
- The recommendation, although somewhat beneficial, does not provide as much benefit as . . .
- The cost of implementing the recommendation is not justified in light of the anticipated benefit.

Before implementing a recommendation, a benefit-cost analysis should be performed to determine if it is worthwhile. The following paragraphs discuss methods for estimating the benefit and cost of a recommendation and determining the benefit-cost ratio.

Benefit

Estimate the benefit of a recommendation by determining the following:

Expected cost of accidents if the recommendation is not implemented

MINUS

Expected cost of accidents after the recommendation is implemented

Revised costs are generally assessed for accidents by changing the risk assessment inputs (failure logic, failure rates, repair rates, etc.) to reflect expected conditions after the recommendation is implemented. In detailed assessments of recommendations, the time when benefits are realized (e.g., only after five years) may be important because of the time value of money.

Cost

Estimate the costs of implementing a recommendation by considering the total life cycle costs of the change:

Initial implementation cost (design, equipment, installation, training, etc.)

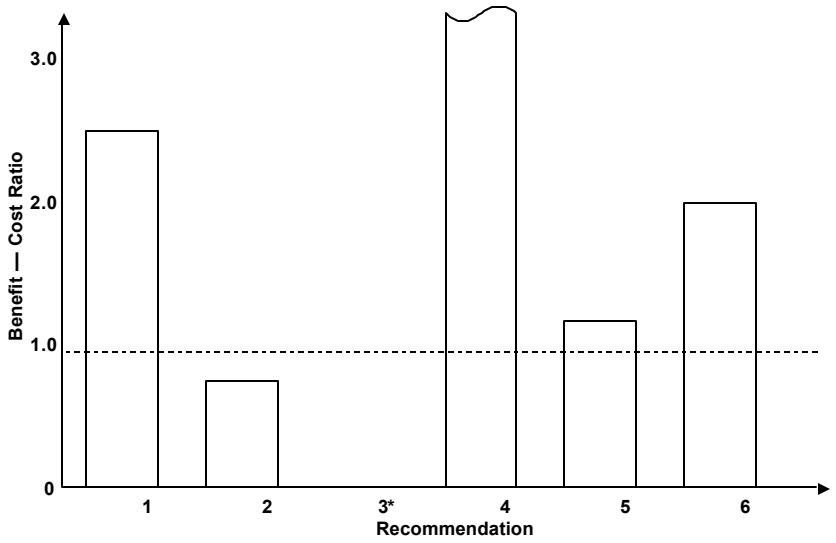
PLUS

Annual costs for ongoing implementation (utilities, maintenance and testing, etc.)

In detailed assessments, the time when costs are realized may be important because of the time value of money.

Benefit-cost ratio

Calculate the benefit-cost ratio by dividing the benefit derived from the recommendation by the cost of implementing it. The following figure is a simple illustration of benefit-cost ratios. Implement recommendations with the largest benefit-cost ratios first, unless (1) the cumulative benefit of implementing several lower-cost items provides a more attractive return on investment or (2) the resources are simply not available to implement relatively expensive items, even if the benefits are substantial.



A benefit-cost ratio of less than 1 indicates that the recommendation is undesirable.

For relatively inexpensive items that seem reasonable, management will often decide to implement the recommendations without detailed benefit-cost analysis because the cost of detailed analysis may be comparable to the cost of implementation.

Reviewing a Risk Assessment

Reviewing a Risk Assessment

At some time, you may have to review a risk assessment that has been conducted by other Coast Guard personnel or by organizations outside of the Coast Guard. The purpose of this section is to provide guidelines for reviewing risk assessments conducted by others. You might also find it valuable to apply these review criteria to your own risk assessments. These criteria are consistent with those applied by the National Research Council to risk assessments during peer reviews.

The intent of this section is NOT to provide you with a checklist for evaluating each type of risk assessment tool; rather, it is to offer guidelines for reviewing any risk assessment using any tool.

The evaluation should cover four areas:

- Scope
- Data collection
- Data analysis
- Recommendations and conclusions

Scope

- **Has the purpose of the risk assessment been clearly defined?**
- **Are the boundaries of the risk assessment defined?**

Scope

The scope of a risk assessment includes the decision framework and the physical and analytical boundaries of the risk assessment.

Review questions

1. **Has the purpose of the risk assessment been clearly defined?** This should include a definition of the decision that needs to be made, the questions that must be answered to make the decision, and the type, precision, and certainty of the information necessary to answer the questions. Once the purpose of the risk assessment has been verified, the rest of the review will focus on judging how well the risk assessment process fulfills its purpose.
2. **Are the boundaries of the risk assessments defined?** Specific boundaries of the analysis are sometimes established. For example, a general risk assessment of a waterway may purposely exclude the risk of marine casualties associated with personal watercraft. For the purposes of a review, the key is to be sure that established constraints are (1) consistent with the purpose of the analysis (e.g., critical issues are not being ignored) and (2) appropriately observed by the analysis team.

Data collection

- **Were appropriate data collected for the risk assessment?**
- **Were data collected from the best sources?**
- **Are raw data included in the risk assessment report?**

Data collection

Data include both qualitative and quantitative information collected and analyzed during an assessment. It is essential to understand how data were collected for the risk assessment. The data collection methods should be clearly defined and defended in the risk assessment report.

Review questions

1. Were appropriate data collected for the risk assessments?

Ask the following:

- Did the risk assessment team develop the types of information needed by the decision makers?
- Is each type of information presented with the precision and certainty required by decision makers?
- Was an appropriate process used to gather and elicit the data dependably?
- Were skilled individuals used to facilitate the data collection process?

2. Were data collected from the best sources?

Ask the following:

- Were appropriate subject matter experts involved throughout the risk assessment?
- Were appropriate databases used to collect historical experience data?
- Were the databases used appropriately?

The Data Sources Compendium under the General Resources directory in Volume 4 of these *Guidelines* is a useful reference for judging the applicability of data for many marine-related risk assessments.

3. Are raw data included in the risk assessment report, or are they otherwise available?

The raw data should be included as an appendix, or should be available in some form, so that the logical progression from data collection to data analysis to recommendations and conclusions is verifiable.

Data analysis

- **Was the data analysis performed competently?**
- **Is it easy to see how the collected data were analyzed?**
- **Are the actual results from the data analysis presented clearly?**

Data analysis

Once the data are collected, they must be analyzed so that proper conclusions can be drawn. As with data collection, the data analysis methods should be clearly defined and defended.

Review questions

1. **Was the data analysis performed competently?** The answer to this question is based on the experience and skill of the analysts as well as whether the analysts used established and accepted methods. Volume 3 of these *Guidelines* illustrates a dozen commonly used data collection and analysis methods, and Volume 4 provides examples of risk assessments that have already been performed.
2. **Is it easy to see how the collected data were analyzed?** The reviewer should be able to easily see how the collected data were treated during the data analysis process. For example, raw data may be itemized on a table. The item numbers are then transferred to the data analysis component of the risk assessment to show how and where the raw data were actually analyzed. Also, data simulations may be used, and the impact from these simulations should be clear.
3. **Are the actual results from the data analysis presented clearly?** Often, large amounts of data are analyzed in a risk assessment. To ensure that the proper recommendations are presented and appropriate conclusions are drawn, the results of the data analysis should be presented in a tabular, matrix, or other summary format. The recommendations and conclusions can then be derived and defended from these summary results.

Recommendations and conclusions

- **Is it easy to see how the recommendations and conclusions were made?**
- **Do the conclusions answer the questions from which the risk-based decisions will be made?**
- **Were sensitive policy issues treated with proper care?**
- **Was the organization of the report effective?**

Recommendations and conclusions

A risk assessment is not complete if it does not contain recommendations and conclusions. Recommendations are made by the analysis team to improve the risk performance. The conclusions are an interpretation of the results of the data analysis. Conclusions are often made about the overall acceptability of risk. They also include other key observations about the risks, such as contributions, costs, vulnerable populations, etc.

Review questions

1. **Is it easy to see how the recommendations and conclusions were made?** The reviewer should be able to easily see how the results from the data analysis were used to generate recommendations and conclusions. Recommendations and conclusions should be defended based on the data analysis results.
2. **Do the conclusions answer the questions from which the risk-based decisions will be made?** If the conclusions do not tie in with the purpose of the analysis, then the risk assessment did not meet its main objective.
3. **Were sensitive policy issues treated with proper care?** Some recommendations and conclusions may be inflammatory to some audiences and should be worded appropriately.
4. **Was the organization of the report effective?** The report itself should clearly lead readers from the scope of the risk assessment through the recommendations and conclusion without the need for additional supporting materials, explanations or presentations.